Fueling The Future

Presented by:

Kirk Burns – Gregory Poole Equipment
Tom Hopkins – ROUSH CleanTech
Product Offering

- BB Vision Gasoline
- BB Vision ISB Diesel
- BB Vision ISV Diesel
- BB Vision Propane
- BB Vision CNG
- BB Vision EV
- BB Transit EV

BB Vision EV

Private & Confidential
Our Partnerships
**Why Propane?**

**COST SAVINGS**

Districts report savings of up to **$.37¢** per mile.

**NOISE REDUCTION**

Up to **40% quieter**

**COLD STARTS**

Starts in temperatures as low as **-40°F**

**LOWEST EMISSIONS**

Incredibly reduced emissions:
- 100% reduced particulate matter
- 60% reduced nitrogen oxide
- 80% reduced hydrocarbons

*than a typical fuel tank*

Blue Bird Alternative Fuel School Buses in the US

OVER 19,000 SCHOOL BUSES SOLD

OVER 1,000 SCHOOL DISTRICTS

#1 manufacturer of alternative fuel school buses
Over 14,000 ROUSH/FORD propane powered Blue Bird Visions sold since introduction
Gregory Poole, NC - Deployments

- CHARLOTTE-MECKLENBURG - 2
- DAVIDSON COUNTY SCHOOLS - 6
- STRAIGHTLINES (High Point) - 2
Blue Bird Vision Propane Product Information

Model Years
2020

Engine Size / Manufacturer
6.8L V10 (3V) Ford Engine with exclusive ROUSH CleanTech Propane Fuel System

Applications
- 189” / 217” / 238” / 252” / 273” / 280” wheelbase configurations
- 6-speed automatic transmission

Fuel Tank Capacity
- Short: 50 gallons (47 usable)
- Standard Range: 70 gallons (67 usable)
- Extended Range: 100 gallons (93 usable)

Technical Specifications
- EPA and CARB approved
- GVWR: 33,000 lbs
- Up to 77 passengers
Blue Bird Vision Propane Highlights

**Fuel Fill**
Industry-standard valve designed to allow for safe passage of liquid propane into the vehicle, including a check valve to prevent fuel leaks.

**Fuel Rail**
ROUSH CleanTech's signature anodized aluminum fuel rail is designed to operate under varying temperatures of liquid propane.

**Fuel Tank**
The liquid propane autogas fuel tank meets all ASME certification standards, is made of carbon steel, and is built and assembled in the USA.

**Fuel Lines**
Made of high-durability stainless steel to handle varying temperatures and pressures and designed to route through the factory line locations.

**Fuel Injectors**
Special fuel injectors are used to inject liquid propane into the cylinders for ignition.

**FRPCM**
The Fuel Rail Pressure Control Module ensures consistent vehicle performance and power on-demand.

**Low NOx**
 LOW NOx

**Low Low NOx**
 LOW LOW NOx
Operational Impact

Controlling Cost / Complexity
Preventative Maintenance

Ford V10
Gas and Propane
7 Quarts

Various Engines
Diesel
17 – 30 Quarts
Increased Inventory

- Gas and Propane eliminate the need for DEF and the possibility of putting the wrong fluid in a tank.

Average diesel needs around 70 gallons / year
Modern Diesel Technology = Complexity & Cost
## Preventative Maintenance

### Ford 6.8L V10

<table>
<thead>
<tr>
<th>Part</th>
<th>Quantity</th>
<th>Price</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>Element Air Cleaner</td>
<td>1</td>
<td>$15.75</td>
<td>$15.75</td>
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<tr>
<td>Oil Spin On Filter</td>
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<td>$4.11</td>
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<tr>
<td>Element, PSR, 510 Filter</td>
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<tr>
<td>Mobil Special 5W-20</td>
<td>7</td>
<td>$3.74</td>
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</table>

Total $70.94

### Cummins ISB 6.7L

<table>
<thead>
<tr>
<th>Part</th>
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<tr>
<td>Oil Filter</td>
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<td>$13.75</td>
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<tr>
<td>Fuel Spin-On Filter</td>
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<td>Power Steering Spin Filter</td>
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<td>Fuel Filter</td>
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<td>Allison Control Filter</td>
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<td>Mobil Fleet 15W-40</td>
<td>18</td>
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<td>Cleaner, Air Element</td>
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<td>$140.00</td>
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Total $277.15
# Ford 6.8L V10

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<td>Vapor Management Valve</td>
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<td>Gasket</td>
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<td>Injector Assembly</td>
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<tr>
<td>Converter Assembly</td>
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<td>$910.00</td>
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<tr>
<td>Spark Plugs</td>
<td>10</td>
<td>$7.08</td>
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<td>O2 Sensors (all 3)</td>
<td>1</td>
<td>102.57</td>
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</table>

Total **$3,348.04**
# Engine Components (Diesel)

## Cummins ISB 6.7L

<table>
<thead>
<tr>
<th>Part</th>
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<tr>
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<td>Pressure Sensor</td>
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<tr>
<td>Doser Injector</td>
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<tr>
<td>Catalyst Assembly w/ DPF</td>
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<tr>
<td>Temperature Sensor</td>
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<tr>
<td>Turbo</td>
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<tr>
<td>Injector</td>
<td>6</td>
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<tr>
<td>EGR Valve</td>
<td>1</td>
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<tr>
<td>EGR Cooler</td>
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<td>$923.72</td>
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**Total** $21,051.24
## Full Engine Replacement

### Ford 6.8L V10

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<tbody>
<tr>
<td>Ford 6.8L Engine</td>
<td>$7,194.85</td>
<td>$900.00</td>
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### Cummins ISB 6.7L

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<thead>
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<th>Part</th>
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<th>Shipping</th>
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<tr>
<td>Cummins ISB 6.7L</td>
<td>$18,521.98</td>
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Total Cost of Ownership Experience
# Savings Calculation (vs. Diesel)

<table>
<thead>
<tr>
<th></th>
<th>Diesel</th>
<th>Blue Bird Propane</th>
<th>Blue Bird Gasoline</th>
<th>Blue Bird C-CNG</th>
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</thead>
<tbody>
<tr>
<td><strong>FUEL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual Miles per Bus</td>
<td>15,000</td>
<td>15,000</td>
<td>15,000</td>
<td>15,000</td>
</tr>
<tr>
<td>Years Operated</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
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<tr>
<td>Total Miles Lifetime Miles per Bus</td>
<td>225,000</td>
<td>225,000</td>
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<tr>
<td>Fuel Economy (mpg)</td>
<td>7.00</td>
<td>4.50</td>
<td>5.75</td>
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<tr>
<td>Gallons Used Annually per Bus</td>
<td>2,142.00</td>
<td>3,333</td>
<td>2,608</td>
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<tr>
<td>Gallons Used Total per Bus</td>
<td>32,142.00</td>
<td>50,000</td>
<td>39,130</td>
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<tr>
<td>Fuel Price / Gallon</td>
<td>$2.95</td>
<td>$1.25</td>
<td>$2.75</td>
<td>$2.05</td>
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<td><strong>PREVENTATIVE MAINTENANCE</strong></td>
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<tr>
<td>Oil Interval</td>
<td>7,000</td>
<td>5,000</td>
<td>5,000</td>
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<tr>
<td>Oil Capacity (Quarts)</td>
<td>21</td>
<td>7</td>
<td>7</td>
<td>7</td>
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<tr>
<td>Oil Filter Cost</td>
<td>$3.36</td>
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<td>$4.00</td>
<td>$4.00</td>
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<tr>
<td>Oil Cost Per Quart</td>
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<tr>
<td>Cost Per Oil Change</td>
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<td>Lifetime Oil Change Total Cost</td>
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<td>$983.25</td>
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<td>Lifetime DEF Gallons</td>
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<td>DEF Cost per Gallon</td>
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<td>DEF Total Cost Over Lifetime</td>
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<td>Fuel Filter Change Interval</td>
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<td>50,000</td>
<td>15,000</td>
<td>5,000</td>
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<tr>
<td>Fuel Filter Cost</td>
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<td>$4.3</td>
<td>$15</td>
<td>$150</td>
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<tr>
<td>Total Filter Changes</td>
<td>15</td>
<td>4</td>
<td>15</td>
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<tr>
<td>Fuel Filter Cost Lifetime</td>
<td>$194.85</td>
<td>$172</td>
<td>$225</td>
<td>$6,750</td>
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<tr>
<td><strong>ACQUISITION COST</strong></td>
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<tr>
<td>Incremental Acquisition Cost</td>
<td>$0.00</td>
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<td>Vehicle Rebate per Unit</td>
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<td>$0.00</td>
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<tr>
<td><strong>TOTAL COST OF OWNERSHIP</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lifetime Operational Cost/Bus</td>
<td>$99,162.05</td>
<td>$70,655.25</td>
<td>$111,315.75</td>
<td>$112,949.75</td>
</tr>
<tr>
<td>Lifetime Savings/Bus</td>
<td>$28,506.80</td>
<td>$-12,153.70</td>
<td>$-13,787.70</td>
<td></td>
</tr>
<tr>
<td>Cost per Mile to Operate</td>
<td>$0.44</td>
<td>$0.28</td>
<td>$0.48</td>
<td>$0.39</td>
</tr>
</tbody>
</table>

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**Customer Information**

- **Propane Fuel Price**
  - $1.25

- **Diesel Fuel Price**
  - $2.95

- **Gasoline Fuel Price**
  - $2.75

- **GGE Fuel Price CNG**
  - $2.05

- **Propane MPG**
  - 4.50 (64%)

- **Diesel MPG**
  - 7.00

- **Gasoline MPG**
  - 5.75 (82%)

- **CNG MPG GGE**
  - 5.75 (82%)

**Years Operated**

- 15

**Annual Miles per Year per Bus**

- 15,000
Savings Calculation (vs. Diesel)

<table>
<thead>
<tr>
<th></th>
<th>Diesel</th>
<th>Blue Bird Propane</th>
<th>Blue Bird Gasoline</th>
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<td><strong>TOTAL COST OF OWNERSHIP</strong></td>
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<td>$0.28</td>
<td>$0.48</td>
<td>$0.39</td>
</tr>
</tbody>
</table>

**TCO Calculator**

**ACQUISITION COST**
- Incremental Acquisition Cost: $0.00
- Vehicle Rebate per Unit: $0.00

**TOTAL COST OF OWNERSHIP**
- Lifetime Operational Cost/Bus: $109,176.60
- Lifetime Savings/Bus: $38,506.65
- Cost per Mile to Operate: $0.49

[Image of a bus with a logo]
Real World Savings

“15 Cents per Mile Savings on Average”

“34 Cents per Mile Savings on Average”

“Over $7,000 per Bus Savings in First Year”

“80% Lower Fuel Costs”
Environment
Low NOx: Background

- CARB (California Air Resources Board)
  - Established a mechanism for engine MFR’s to pursue lower NOx certification than Federal requirement of 0.20 g/bhp-hr
    - 50% lower or 0.10
    - 75% lower or 0.05
    - 90% lower or 0.02
  - CA, CT, ME, NY, DC
Achievement of Ultra Low NOx starts with a high quality production engine

- ARB is encouraging all Manufacturers of Record (MORs) to overachieve on the NOx standard to support smog reduction.

**Blue Bird Vision Propane**

*The Most Cost-Effective Solution to Reduce NOx Emissions from School Buses*

- **Propane**
  - Purchase price: 99.00
  - 890 cpg
  - Cost per pound of NOx reduced: $0.08

- **Diesel**
  - Purchase price: 99.00
  - 17.8 cpg
  - Cost per pound of NOx reduced: $1.32

- **Electric**
  - Purchase price: 112.00
  - 0 cpg
  - Cost per pound of NOx reduced: $2.00

- **92%**
  - 92% cleaner for NOx emissions

- **60%**
  - 60% cleaner for CO emissions

- **750+**
  - School Transportation buses in operation

- **12,000+**
  - School Transportation buses in operation in North America
WVU In-Use Study

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Propane (LPG)</th>
<th>Ultra-Low Sulfur Diesel</th>
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</thead>
<tbody>
<tr>
<td>Vehicle</td>
<td>Blue Bird School Bus (6.8L, 10 Cylinder)</td>
<td>Blue Bird School Bus (6.7L, 6 Cylinder)</td>
</tr>
<tr>
<td>Model Year</td>
<td>2015</td>
<td>2014</td>
</tr>
<tr>
<td>Exhaust Aftertreatment</td>
<td>Three-Way Catalyst</td>
<td>Diesel Oxidation Catalyst, Diesel Particulate Filter, Selective Catalytic Reduction System</td>
</tr>
</tbody>
</table>

Noteworthy Results:

- 96% NOx reduction
- >95% NOx reduction
- >93% NOx reduction
- >13% CO2 reduction
The EPA has strict requirements surrounding AST and UST systems that hold diesel and gasoline

- Above Ground Storage Tanks and Below Ground Storage Tanks

- The EPA estimates that the average remediation is $130,000

- If groundwater is affected, the correction can exceed $1,000,000
Safety

- When Propane Autogas is released from the tank it is a vapor, therefore cannot be ingested like gasoline, diesel, or alcohol fuels

- Propane is an odorless gas
  - Ethyl mercaptan is added so any presence of propane may be easily detected

- Propane Autogas tanks are 20 times more puncture-resistant than standard fuel tanks, so they are more durable in an accident

- The ROUSH CleanTech fuel system is fitted with safety devices and shut-off valves that function automatically if the fuel line ruptures
Crash Testing

- Blue Bird is certified to **CMVSS 301.1** testing protocol
- 4,000 lbs. @ 30 MPH
- Angled side and rear impact

Other Features

- In the quest to design and manufacture the safest school bus in the industry, Blue Bird school buses are always in compliance with both the **Colorado Rack Test** and the **Kentucky Pole Test**—Blue Bird is the only school bus manufacturer that has both tests as a requirement
  - **Colorado Rack Test:** Ensures that the structural integrity of the bus remains intact in the event of a rollover accident
  - **Kentucky Pole Test:** Ensures the strength of the school bus roof in case of a pole, or another sharp object impacts the bus during a rollover
Refueling Infrastructure
Fuel Budget: PROPANE

Fuel Price History

- Propane has a stable price history
  - Recent surge in gasoline and diesel
- Price lock contracting for multiple years
- Eligible for rebates, bringing District dollars back
Low Cost Fueling Infrastructure

Ford Michigan Assembly Plant (MI)

AmeriGas Propane Tank

Kyrene Elementary School (AZ)

Bend LaPine School District (OR)

ROUSH CleanTech (MI)
Fueling Infrastructure

- Propane fuel transfers as fast as gasoline or diesel but with these added benefits:
  - Secured connection, no spillage
  - No diesel residual on pump handle
  - No residual on the ground
  - Non-carcinogenic

- Propane is non-toxic and dissipates into the atmosphere
Propane Consideration Summary

☑ Simple and Robust Design
☑ No Duty Cycle Compromise
☑ Economical Operation
☑ Safe by Composition and Design
☑ Environmentally Responsible from Well to Wheels
Blue Bird Electric School Bus

Presented by:
Kuba Szczypiorski
Director - Alternative Fuels
Blue Bird Corporation
Benefits

- **ZERO EMISSIONS**
  Cleaner air for our children

- **REDUCED MAINTENANCE COSTS**
  Less parts means less maintenance

- **TEMPERATURE CONTROL**
  Excellent performance in many weather conditions

- **GO FURTHER**
  Go approximately 100 miles on a single charge

- **VEHICLE TO GRID TECHNOLOGY**
  (V2G) technology will allow you to “sell” energy back into the grid

- **BATTERY CAPACITY**
  Multiple battery capacities: 100-150kWh options

- No Engine Oil Changes, No Transmission, No Engine
- Up to 120 miles on a single charge. 80% of school bus routes are 80 miles or less.
  - 315 HP - 2,176 ft/lb TORQUE - Up top 65 MPH
  - Lithium Nickel-Manganese-Cobalt Battery
  - Level 2 Charger – Approx 8 Hour Charge Time
Blue Bird’s purpose-built chassis combines over 90 years of innovation with our exclusive drivetrain partners ADOMANI and Efficient Drivetrains (EDI), which was recently acquired by Cummins Inc., allowing us to offer efficient and affordable electric bus solutions.
**EV Charging Options**

- **AC Level 1:** Uses a 120-volt (V) alternate current (AC) power connection to a standard residential / commercial outlet capable of supplying 12-16 amps of current, for a power draw of about 1.4 to 1.9 kW when charging.

- **AC Level 2:** Uses a 208 / 240V AC power connection to an electrical outlet capable of supplying 30-80 amps of current with 19.2 kW max—EV school buses can use AC Level 2 EVSE but require higher amperage and can charge a 160 kWh electric school bus between eight and nine hours and cost $3,000-$10,000, including purchase price and installation.

- **DC Fast Charging:** Delivers high power directly into an electric vehicle battery system by converting AC into DC, using an inverter built into the EVSE and uses 208-600V AC for charging rates of up to 90 kW, enabling an EV school bus to be charged in between 20-30 minutes—DC Fast Charging systems are more expensive: $15,000 for hardware not including installation, plus another $10,000-$20,000 for software costs.

- **Bidirectional Charging (VTG):** Allows EVs to both receive energy from the grid and send energy stored in the vehicle back to the grid or a building enabling the vehicle battery to function as an energy storage resource either though an on-board system located on the bus or an off-board system which is stationary inverter located in a DC fast charger equipped for bidirectional power flow.
September 27, 2018: Blue Bird just delivered the first electric-powered school buses to customers in California and Ontario, just in time for the new school year. Seven Type-D All American Rear Engine Electric school buses and one Type A Micro Bird G5 Electric school bus will be in operation this year.
# Your Fuel Options

<table>
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<tr>
<th></th>
<th>Prop</th>
<th>Gas</th>
<th>Propane</th>
<th>CNG</th>
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<tbody>
<tr>
<td>Ease of Adoption</td>
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<td>✔</td>
<td>✔</td>
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<tr>
<td>Energy Independence</td>
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<tr>
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Propane Checks Every Box
Thank You!

Questions?